FIG.1

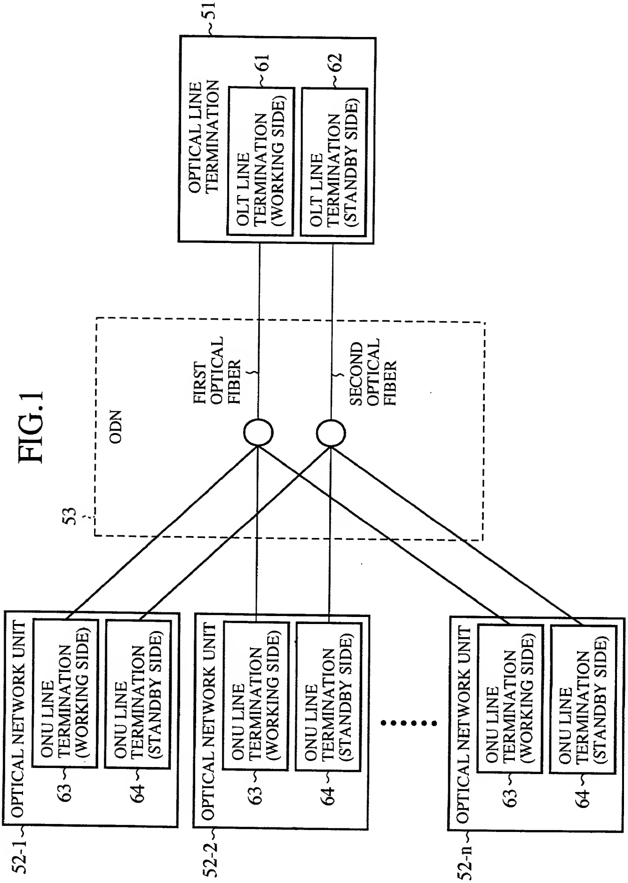

51
OPTICAL LINE TERMINATION
61
OLT LINE TERMINATION (WORKING SIDE)
62
OLT LINE TERMINATION (STANDBY SIDE)
ODN
53
FIRST OPTICAL FIBER
SECOND OPTICAL FIBER
52-1
52-2
52-n
OPTICAL NETWORK UNIT
63
ONU LINE TERMINATION (WORKING SIDE)
64
ONU LINE TERMINATION (STANDBY SIDE)
......

FIG.2

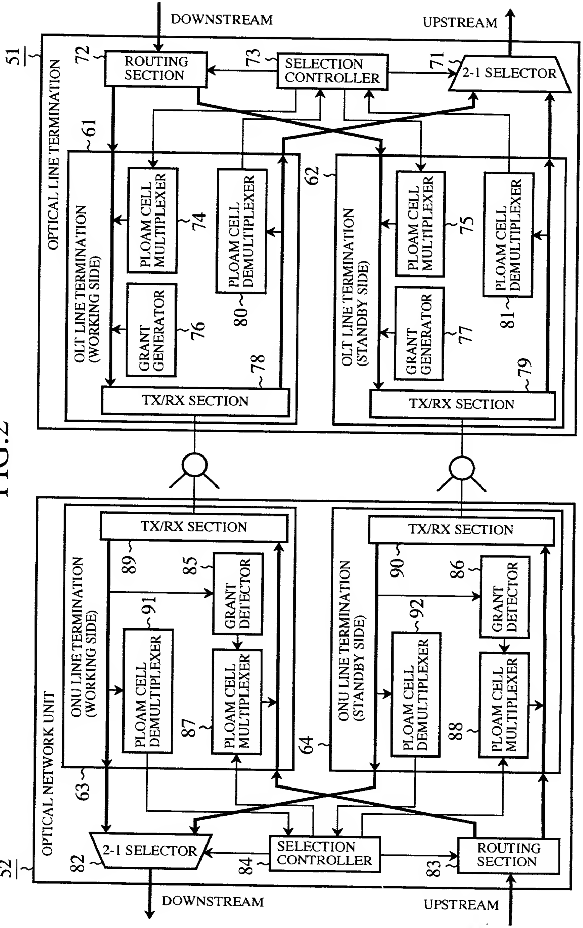

DOWNSTREAM
UPSTREAM
51
OPTICAL LINE TERMINATION
72
ROUTING SECTION
73
SELECTION CONTROLLER
71
2-1 SELECTOR
61
OLT LINE TERMINATION (WORKING SIDE)
PLOAM CELL MULTIPLEXER
74
PLOAM CELL DEMULTIPLEXER
80
GRANT GENERATOR
76
78
TX/RX SECTION
62
OLT LINE TERMINATION (STANDBY SIDE)
PLOAM CELL MULTIPLEXER
75
PLOAM CELL DEMULTIPLEXER
81
GRANT GENERATOR
77
79
TX/RX SECTION
52
OPTICAL NETWORK UNIT
TX/RX SECTION
ONU LINE TERMINATION (WORKING SIDE)
89
85
GRANT DETECTOR
91
PLOAM CELL DEMULTIPLEXER
87
PLOAM CELL MULTIPLEXER
63
TX/RX SECTION
ONU LINE TERMINATION (STANDBY SIDE)
90
86
GRANT DETECTOR
92
PLOAM CELL DEMULTIPLEXER
88
PLOAM CELL MULTIPLEXER
64
82
2-1 SELECTOR
84
SELECTION CONTROLLER
83
ROUTING SECTION
DOWNSTREAM
UPSTREAM

FIG.3

CONTROL EXAMPLE (NON-REVERTIVE MODE)

FAULT STATE	ONU TO OLT		OLT TO ONU		OPERATION		
	K1 BYTE	K2 BYTE	K1 BYTE	K2 BYTE	ONU	OLT	
NO FAILURE	NO SW REQ.	(ONU IS) SELECTING WS	NO SW REQ.	(OLT IS) SELECTING WS	SL IS OPERATING IN WS	SL IS WORKING AT WS	~ S11
EQUIPMENT FAILURE OCCURS IN WS TX/RX OF ONU	SW REQ. BY WORKING SF	(ONU IS) SELECTING WS	NO SW REQ.	(OLT IS) SELECTING WS	DETECT SW REQ. BY WORKING SF; SL IS WORKING AT WS; UPDATE T-K1 BYTE	SL IS WORKING AT WS	~ S12
	SW REQ. BY WORKING SF	(ONU IS) SELECTING WS	NO SW REQ.	(OLT IS) SELECTING SS	DETECT SW REQ. BY WORKING SF; SL IS WORKING AT WS; UPDATE T-K1 BYTE	DETECT RR BY RECEIVING K1/K2; SL IS SWITCHED TO SS; UPDATE T-K2 BYTE	~ S13
	SW REQ. BY WORKING SF	(ONU IS) SELECTING SS	NO SW REQ.	(OLT IS) SELECTING SS	DETECT RR BY RECEIVING K2; SL IS SWITCHED TO SS; UPDATE T-K2 BYTE	DETECT RR BY RECEIVING K1/K2; SL IS SWITCHED TO SS; UPDATE T-K2 BYTE	~ S14
EQUIPMENT FAILURE IS RESTORED IN WS TX/RX OF ONU	DO NOT REVERT TO WS	(ONU IS) SELECTING SS	NO SW REQ.	(OLT IS) SELECTING SS	DETECT SW REQ. CLEAR; DO NOT REVERT STATE; UPDATE T-K1 BYTE	DETECT RR BY RECEIVING K1/K2; SL IS SWITCHED TO SS; UPDATE T-K2 BYTE	~ S15
SIGNAL DEGRADE OCCURS IN SS TX/RX OF ONU	SW REQ. BY STANDBY SD	(ONU IS) SELECTING SS	NO SW REQ.	(OLT IS) SELECTING SS	DETECT SW REQ. BY WS SD; SL IS OPERATING AT SS; UPDATE T-K1 BYTE	DETECT RR BY RECEIVING K1/K2; SL IS SWITCHED TO SS; UPDATE T-K2 BYTE	~ S16
	SW REQ. BY STANDBY SD	(ONU IS) SELECTING SS	NO SW REQ.	(OLT IS) SELECTING WS	DETECT SW REQ. BY WS SD; SL IS OPERATING AT SS; UPDATE T-K1 BYTE	DETECT RR BY RECEIVING K1/K2; SL IS SWITCHED TO WS; UPDATE T-K2 BYTE	~ S17

FIG.4

SIGNAL DEGRADE OCCURS IN SS TX/RX OF ONU	SW REQ. BY STANDBY SD	(ONU IS) SELECTING WS	NO SW REQ.	(OLT IS) SELECTING WS	DETECT RR BY RECEIVING K2; SL IS SWITCHED TO WS; UPDATE T-K2 BYTE	DETECT RR BY RECEIVING K1/K2; SL IS SWITCHED TO WS; UPDATE T-K2 BYTE	~S18
SIGNAL DEGRADE IS RESTORED IN SS TX/RX OF ONU	NO SW REQ.	(ONU IS) SELECTING WS	NO SW REQ.	(OLT IS) SELECTING WS	NO REQ.; UPDATE K1 BYTE	DETECT RR BY RECEIVING K1/K2; SL IS SWITCHED TO WS; UPDATE T-K2 BYTE	~S19

NOTES: WS = WORKING SIDE
SS = STANDBY SIDE
TX/RX = TRANSMITTING AND RECEIVING SECTION
ONU = OPTICAL NETWORK UNIT
OLT = OPTICAL LINE TERMINATION
SW = SWITCH OR SWITCHING
REQ. = REQUEST
SF = SIGNAL FAIL
SD = SIGNAL DEGRADE
T-K1 = TRANSMISSION K1 BYTE
T-K2 = TRANSMISSION K2 BYTE
RR = REMOTE REQUEST
SL = SELECTOR

FIG.5

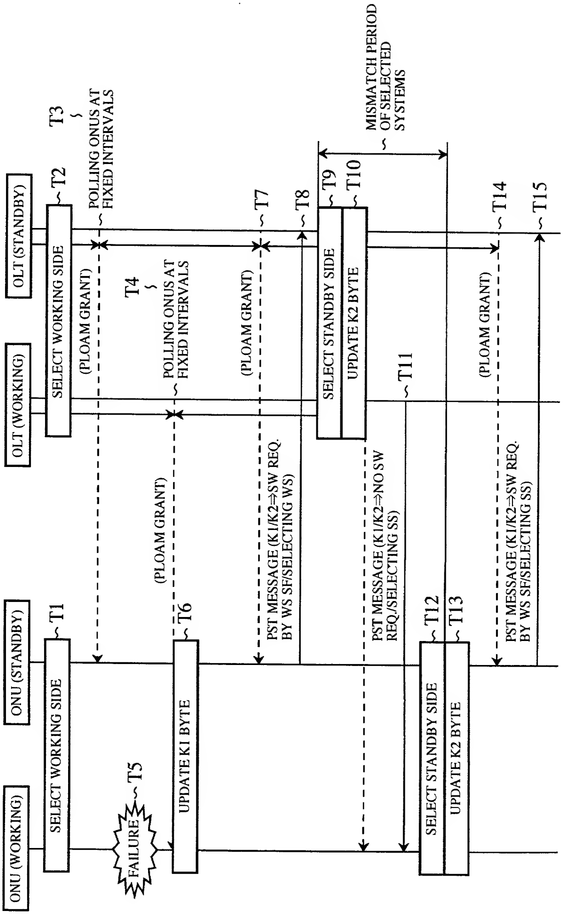

ONU (WORKING)
ONU (STANDBY)
OLT (WORKING)
OLT (STANDBY)
SELECT WORKING SIDE
T1
SELECT WORKING SIDE
T2
T3
POLLING ONUS AT FIXED INTERVALS
(PLOAM GRANT)
T4
POLLING ONUS AT FIXED INTERVALS
(PLOAM GRANT)
FAILURE
T5
UPDATE K1 BYTE
T6
T7
(PLOAM GRANT)
PST MESSAGE (K1/K2⇒SW REQ. BY WS SF/SELECTING WS)
T8
SELECT STANDBY SIDE
T9
UPDATE K2 BYTE
T10
MISMATCH PERIOD OF SELECTED SYSTEMS
PST MESSAGE (K1/K2⇒NO SW REQ./SELECTING SS)
T11
SELECT STANDBY SIDE
T12
UPDATE K2 BYTE
T13
T14
(PLOAM GRANT)
PST MESSAGE (K1/K2⇒SW REQ. BY WS SF/SELECTING SS)
T15

FIG.6

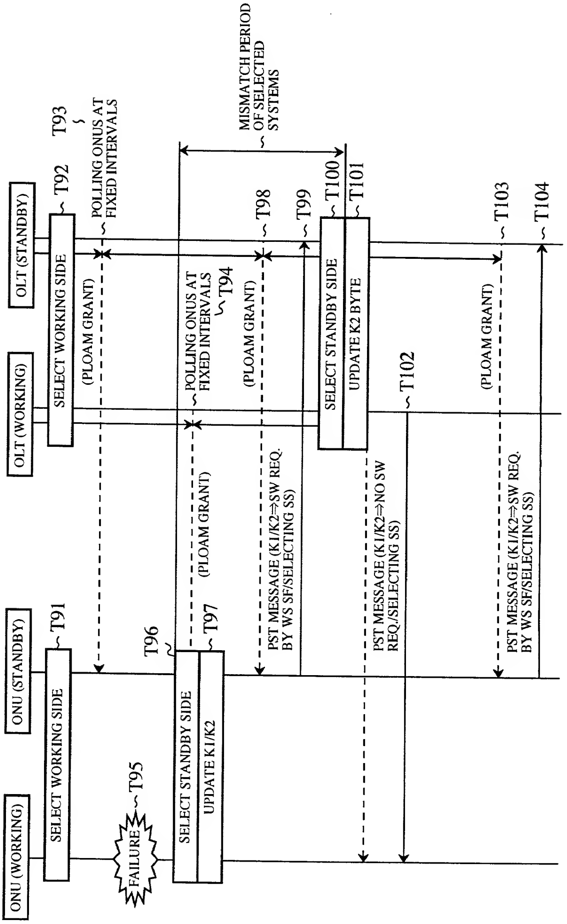

OLT (STANDBY)
OLT (WORKING)
ONU (STANDBY)
ONU (WORKING)
SELECT WORKING SIDE
T92
T93
POLLING ONUS AT FIXED INTERVALS
(PLOAM GRANT)
MISMATCH PERIOD OF SELECTED SYSTEMS
POLLING ONUS AT FIXED INTERVALS
T94
(PLOAM GRANT)
T98
T99
T100
T101
SELECT STANDBY SIDE
UPDATE K2 BYTE
T102
(PLOAM GRANT)
T103
T104
(PLOAM GRANT)
PST MESSAGE (K1/K2⇒SW REQ. BY WS SF/SELECTING SS)
PST MESSAGE (K1/K2⇒NO SW REQ./SELECTING SS)
PST MESSAGE (K1/K2⇒SW REQ. BY WS SF/SELECTING SS)
SELECT WORKING SIDE
T91
T96
T97
FAILURE
T95
SELECT STANDBY SIDE
UPDATE K1/K2

FIG.7

CONTROL EXAMPLE (REVERTIVE MODE)

FAULT STATE	ONU TO OLT		OLT TO ONU		OPERATION		
	K1 BYTE	K2 BYTE	K1 BYTE	K2 BYTE	ONU	OLT	
NO FAILURE	NO SW REQ.	(ONU IS) SELECTING WS	NO SW REQ.	(OLT IS) SELECTING WS	SL IS OPERATING IN WS	SL IS WORKING AT WS	~ S11
EQUIPMENT FAILURE OCCURS IN WS TX/RX OF ONU	SW REQ. BY WORKING SF	(ONU IS) SELECTING WS	NO SW REQ.	(OLT IS) SELECTING WS	DETECT SW REQ. BY WORKING SF; SL IS WORKING AT WS; UPDATE T-K1 BYTE	SL IS WORKING AT WS	~ S12
	SW REQ. BY WORKING SF	(ONU IS) SELECTING WS	NO SW REQ.	(OLT IS) SELECTING SS	DETECT SW REQ. BY WORKING SF; SL IS WORKING AT WS; UPDATE T-K1 BYTE	DETECT RR BY RECEIVING K1/K2; SL IS SWITCHED TO SS; UPDATE T-K2 BYTE	~ S13
	SW REQ. BY WORKING SF	(ONU IS) SELECTING SS	NO SW REQ.	(OLT IS) SELECTING SS	DETECT RR BY RECEIVING K2; SL IS SWITCHED TO SS; UPDATE T-K2 BYTE	DETECT RR BY RECEIVING K1/K2; SL IS SWITCHED TO SS; UPDATE T-K2 BYTE	~ S14
EQUIPMENT FAILURE IS RESTORED IN WS TX/RX OF ONU	REQUESTING TO REVERT TO WS	(ONU IS) SELECTING SS	NO SW REQ.	(OLT IS) SELECTING SS	DETECT SW REQ. CLEAR; WAIT TO REVERT STATE; UPDATE T-K1 BYTE	START RESTORE TIMER; SL IS OPERATING AT SS	~ S21
REVERSION WAITING EXPIRES AT OLT	WAITING TO REVERT TO WS	(ONU IS) SELECTING SS	NO SW REQ.	(OLT IS) SELECTING WS	DETECT SW REQ. CLEAR; WAIT TO REVERT STATE; UPDATE T-K1 BYTE	STOP RESTORE TIMER; SL IS SWITCHED TO WS; UPDATE T-K2 BYTE	~ S22
	NO SW REQ.	(ONU IS) SELECTING WS	NO SW REQ.	(OLT IS) SELECTING WS	DETECT RR BY RECEIVING K2; SL IS SWITCHED TO WS; UPDATE K1 BYTE	STOP RESTORE TIMER; SL IS SWITCHED TO WS; UPDATE T-K2 BYTE	~ S23

FIG.8

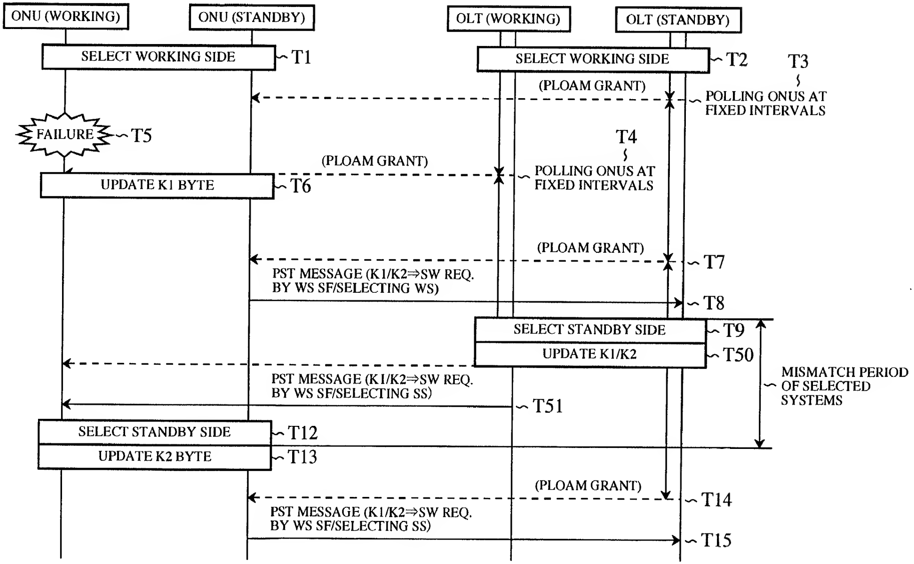

ONU (WORKING)
ONU (STANDBY)
OLT (WORKING)
OLT (STANDBY)
SELECT WORKING SIDE
T1
SELECT WORKING SIDE
T2
T3
(PLOAM GRANT)
POLLING ONUS AT FIXED INTERVALS
FAILURE
T5
T4
(PLOAM GRANT)
POLLING ONUS AT FIXED INTERVALS
UPDATE K1 BYTE
T6
(PLOAM GRANT)
T7
PST MESSAGE (K1/K2⇒SW REQ. BY WS SF/SELECTING WS)
T8
SELECT STANDBY SIDE
T9
UPDATE K1/K2
T50
MISMATCH PERIOD OF SELECTED SYSTEMS
PST MESSAGE (K1/K2⇒SW REQ. BY WS SF/SELECTING SS)
T51
SELECT STANDBY SIDE
T12
UPDATE K2 BYTE
T13
(PLOAM GRANT)
T14
PST MESSAGE (K1/K2⇒SW REQ. BY WS SF/SELECTING SS)
T15

FIG.9

CONTROL EXAMPLE (NON-REVERTIVE MODE)

FAULT STATE	ONU TO OLT		OLT TO ONU		OPERATION		
	K1 BYTE	K2 BYTE	K1 BYTE	K2 BYTE	ONU	OLT	
NO FAILURE	NO SW REQ.	(ONU IS) SELECTING WS	NO SW REQ.	(OLT IS) SELECTING WS	SL IS OPERATING IN WS	SL IS WORKING AT WS	~S11
EQUIPMENT FAILURE OCCURS IN WS TX/RX OF ONU	SW REQ. BY WORKING SF	(ONU IS) SELECTING WS	NO SW REQ.	(OLT IS) SELECTING WS	DETECT SW REQ. BY WORKING SF; SL IS WORKING AT WS; UPDATE T-K1 BYTE	SL IS WORKING AT WS	~S12
	SW REQ. BY WORKING SF	(ONU IS) SELECTING WS	SW REQ. BY WORKING SF	(OLT IS) SELECTING SS	DETECT SW REQ. BY WORKING SF; SL IS WORKING AT WS; UPDATE T-K1 BYTE	DETECT RR BY RECEIVING K1/K2; SL IS SWITCHED TO SS; UPDATE T-K1/K2 BYTES	~S13'
	SW REQ. BY WORKING SF	(ONU IS) SELECTING SS	SW REQ. BY WORKING SF	(OLT IS) SELECTING SS	DETECT RR BY RECEIVING K1/K2; SL IS SWITCHED TO SS; UPDATE T-K2 BYTE	DETECT RR BY RECEIVING K1/K2; SL IS SWITCHED TO SS; UPDATE T-K1/K2 BYTES	~S14'
EQUIPMENT FAILURE IS RESTORED IN WS TX/RX OF ONU	DO NOT REVERT TO WS	(ONU IS) SELECTING SS	SW REQ. BY WORKING SF	(OLT IS) SELECTING SS	DETECT SW REQ. CLEAR; UPDATE T-K1 BYTE; DO NOT REVERT STATE	DETECT RR BY RECEIVING K1/K2; SL IS SWITCHED TO SS; UPDATE T-K1/K2 BYTES	~S15'
	DO NOT REVERT TO WS	(ONU IS) SELECTING SS	DO NOT REVERT TO WS	(OLT IS) SELECTING SS	DETECT SW REQ. CLEAR; UPDATE T-K1 BYTE; DO NOT REVERT STATE	DETECT RR RELEASE BY RECEIVING K1/K2; DO NOT REVERT STATE; UPDATE T-K1 BYTE	~S15"
SIGNAL DEGRADE OCCURS IN SS TX/RX OF ONU	SW REQ. BY STANDBY SD	(ONU IS) SELECTING SS	DO NOT REVERT TO WS	(OLT IS) SELECTING SS	DETECT SW REQ. BY WS SD; SL IS OPERATING AT SS; UPDATE T-K1 BYTE	DETECT RR RELEASE BY RECEIVING K1/K2; DO NOT REVERT STATE; UPDATE T-K1 BYTE	~S16'

FIG.10

SIGNAL DEGRADE OCCURS IN SS TX/RX OF ONU	SW REQ. BY STANDBY SD	(ONU IS) SELECTING SS	SW REQ. BY STANDBY SD	(OLT IS) SELECTING WS	DETECT SW REQ. BY WS SD; SL IS OPERATING AT SS; UPDATE T-K1 BYTE	DETECT RR BY RECEIVING K1/K2; SL IS SWITCHED TO WS; UPDATE T-K1/K2 BYTES	S17'
	SW REQ. BY STANDBY SD	(ONU IS) SELECTING WS	SW REQ. BY STANDBY SD	(OLT IS) SELECTING WS	DETECT RR BY RECEIVING K1 AND K2; SL SWITCHED TO WS; UPDATE T-K2 BYTE	DETECT RR BY RECEIVING K1/K2; SL IS SWITCHED TO WS; UPDATE T-K1/K2 BYTES	S18'
SIGNAL DEGRADE IS RESTORED IN SS TX/RX OF ONU	NO SW REQ.	(ONU IS) SELECTING WS	SW REQ. BY STANDBY SD	(OLT IS) SELECTING WS	NO REQ.; UPDATE K1 BYTE	DETECT RR BY RECEIVING K1/K2; SL IS SWITCHED TO WS; UPDATE T-K1/K2 BYTES	S19'
	NO SW REQ.	(ONU IS) SELECTING WS	NO SW REQ.	(OLT IS) SELECTING WS	NO REQ.; UPDATE K1 BYTE	NO REQ.; UPDATE K1 BYTE	S19"

FIG.11

CONTROL EXAMPLE (REVERTIVE MODE)

FAULT STATE	ONU TO OLT		OLT TO ONU		OPERATION		
	K1 BYTE	K2 BYTE	K1 BYTE	K2 BYTE	ONU	OLT	
NO FAILURE	NO SW REQ.	(ONU IS) SELECTING WS	NO SW REQ.	(OLT IS) SELECTING WS	SL IS OPERATING IN WS	SL IS WORKING AT WS	~S11
EQUIPMENT FAILURE OCCURS IN WS TX/RX OF ONU	SW REQ. BY WORKING SF	(ONU IS) SELECTING WS	NO SW REQ.	(OLT IS) SELECTING WS	DETECT SW REQ. BY WORKING SF; SL IS WORKING AT WS; UPDATE T-K1 BYTE	SL IS WORKING AT WS	~S12
	SW REQ. BY WORKING SF	(ONU IS) SELECTING WS	SW REQ. BY WORKING SF	(OLT IS) SELECTING SS	DETECT SW REQ. BY WORKING SF; SL IS WORKING AT WS; UPDATE T-K1 BYTE	DETECT RR BY RECEIVING K1/K2; SL IS SWITCHED TO SS; UPDATE T-K1/K2 BYTES	~S13'
	SW REQ. BY WORKING SF	(ONU IS) SELECTING SS	SW REQ. BY WORKING SF	(OLT IS) SELECTING SS	DETECT RR BY RECEIVING K1/K2; SL IS SWITCHED TO SS; UPDATE T-K2 BYTE	DETECT RR BY RECEIVING K1/K2; SL IS SWITCHED TO SS; UPDATE T-K1/K2 BYTES	~S14'
EQUIPMENT FAILURE IS RESTORED IN WS TX/RX OF ONU	REQUESTING TO REVERT TO WS	(ONU IS) SELECTING SS	SW REQ. BY WORKING SF	(OLT IS) SELECTING SS	DETECT SW REQ. CLEAR; UPDATE T-K1 BYTE	DETECT RR BY RECEIVING K1/K2; SL IS SWITCHED TO SS; UPDATE T-K1/K2 BYTES	~S21'
	REQUESTING TO REVERT TO WS	(ONU IS) SELECTING SS	REQUESTING TO REVERT TO WS	(OLT IS) SELECTING SS	DETECT SW REQ. CLEAR; UPDATE T-K1 BYTE	DETECT RR RELEASE BY RECEIVING K1/K2; WAIT TO REVERT STATE; START RESTORE TIMER; UPDATE T-K1 BYTE	~S21"

FIG.12

REVERSION WAITING EXPIRES AT OLT	WAITING TO REVERT TO WS	(ONU IS) SELECTING SS	NO SW REQ.	(OLT IS) SELECTING WS	DETECT SW REQ. CLEAR; UPDATE T-K1 BYTE	STOP RESTORE TIMER; SL IS SWITCHED TO WS; NO REQ. STATE; UPDATE T-K1/K2 BYTES	S22'
	NO SW REQ.	(ONU IS) SELECTING SW	NO SW REQ.	(OLT IS) SELECTING WS	DETECT RR BY RECEIVING K1/K2; NO SW REQ. STATE; SL IS SWITCHED TO WS; UPDATE T-K2 BYTE		S23'

FIG.13

FAULT STATE	ONU TO OLT		OLT TO ONU		OPERATION		
	K1 BYTE	K2 BYTE	K1 BYTE	K2 BYTE	ONU	OLT	
NO FAILURE	NO SW REQ.	(ONU) ESTABLISHES ITS ROUTE TO WS	NO SW REQ.	(OLT) ESTABLISHES ITS ROUTE TO WS	ROUTER AND SL ARE OPERATING AT WS	ROUTER AND SL ARE OPERATING AT WS	S31
EQUIPMENT FAILURE OCCURS IN WS TX/RX OF ONU	SW REQ. BY WORKING SF	(ONU) ESTABLISHES ITS ROUTE TO WS	NO SW REQ.	(OLT) ESTABLISHES ITS ROUTE TO WS	DETECT SW REQ. BY WORKING SF; SL IS WORKING AT WS; UPDATE T-K1 BYTE	ROUTER AND SL ARE OPERATING AT WS	S32
	SW REQ. BY WORKING SF	(ONU) ESTABLISHES ITS ROUTE TO WS	ACK	(OLT) ESTABLISHES ITS ROUTE TO SS	DETECT SW REQ. BY WORKING SF; SL IS WORKING AT WS; UPDATE T-K1 BYTE	DETECT RR BY RECEIVING K1/K2 BYTES; ROUTER IS SWITCHED TO SS; UPDATE T-K1/K2 BYTES	S33
	SW REQ. BY WORKING SF	(ONU) ESTABLISHES ITS ROUTE TO SS	ACK	(OLT) ESTABLISHES ITS ROUTE TO SS	DETECT RR BY RECEIVING K1/K2 BYTES; SL IS SWITCHED TO SS; ROUTER IS SWITCHED TO SS; UPDATE T-K2 BYTE	DETECT RR BY RECEIVING K1/K2 BYTES; ROUTER IS SWITCHED TO SS; UPDATE T-K1/K2 BYTES	S34
	SW REQ. BY WORKING SF	(ONU) ESTABLISHES ITS ROUTE TO SS	ACK	(OLT) ESTABLISHES ITS ROUTE TO SS	DETECT RR BY RECEIVING K1/K2 BYTES; SL IS SWITCHED TO SS; ROUTER IS SWITCHED TO SS; UPDATE T-K2 BYTE	DETECT RR BY RECEIVING K1/K2 BYTES; SL IS SWITCHED TO SS	S35
EQUIPMENT FAILURE IS RESTORED IN WS TX/RX OF ONU	DO NOT REVERT TO WS	(ONU) ESTABLISHES ITS ROUTE TO SS	ACK	(OLT) ESTABLISHES ITS ROUTE TO SS	DETECT SW REQ. CLEAR; DO NOT REVERT STATE; UPDATE T-K1 BYTE	DETECT RR BY RECEIVING K1/K2 BYTES; SL IS SWITCHED TO SS	S36

FIG.14

SIGNAL DEGRADE OCCURS IN SS TX/RX OF ONU	SW REQ. BY STANDBY SD	(ONU) ESTABLISHES ITS ROUTE TO SS	NO SW REQ.	(OLT) ESTABLISHES ITS ROUTE TO SS	DETECT SW REQ. BY WS SD; SL IS OPERATING AT SS; UPDATE T-K1 BYTE	DETECT RR BY RECEIVING K1/K2 BYTES; SL IS SWITCHED TO SS	S37
	SW REQ. BY STANDBY SD	((ONU) ESTABLISHES ITS ROUTE TO SS	ACK	(OLT) ESTABLISHES ITS ROUTE TO WS	DETECT SW REQ. BY WS SD; SL IS OPERATING AT SS; UPDATE T-K1 BYTE	DETECT RR BY RECEIVING K1/K2 BYTES; ROUTER IS SWITCHED TO SS; UPDATE T-K1/K2 BYTES	S38
	SW REQ. BY STANDBY SD	(ONU) ESTABLISHES ITS ROUTE TO WS	ACK	(OLT) ESTABLISHES ITS ROUTE TO WS	DETECT RR BY RECEIVING K1/K2 BYTES; SL IS SWITCHED TO SS; ROUTER IS SWITCHED TO SS; UPDATE T-K2 BYTE	DETECT RR BY RECEIVING K1/K2 BYTES; ROUTER IS SWITCHED TO SS; UPDATE T-K1/K2 BYTES	S39
	SW REQ. BY STANDBY SD	(ONU) ESTABLISHES ITS ROUTE TO WS	ACK	(OLT) ESTABLISHES ITS ROUTE TO WS	DETECT RR BY RECEIVING K1/K2 BYTES; SL IS SWITCHED TO SS; ROUTER IS SWITCHED TO SS; UPDATE T-K2 BYTE	DETECT RR BY RECEIVING K1/K2 BYTES; SL IS SWITCHED TO SS	S40
SIGNAL DEGRADE IS RESTORED IN SS TX/RX OF ONU	NO SW REQ.	(ONU) ESTABLISHES ITS ROUTE TO WS	ACK	(OLT) ESTABLISHES ITS ROUTE TO WS	NO REQ.; UPDATE K1 BYTE	DETECT RR BY RECEIVING K1/K2 BYTES; SL IS SWITCHED TO SS	S41
	NO SW REQ.	(ONU) ESTABLISHES ITS ROUTE TO WS	NO SW REQ.	(OLT) ESTABLISHES ITS ROUTE TO WS	NO REQ.; UPDATE K1 BYTE	NO REQ.; UPDATE K1 BYTE	S42

FIG.15

FAULT STATE	ONU TO OLT		OLT TO ONU		OPERATION		
	K1 BYTE	K2 BYTE	K1 BYTE	K2 BYTE	ONU	OLT	
NO FAILURE	NO SW REQ.	(ONU) ESTABLISHES ITS ROUTE TO WS	NO SW REQ.	(OLT) ESTABLISHES ITS ROUTE TO WS	ROUTER AND SL ARE OPERATING AT WS	ROUTER AND SL ARE OPERATING AT WS	S31
EQUIPMENT FAILURE OCCURS IN WS TX/RX OF ONU	SW REQ. BY WORKING SF	(ONU) ESTABLISHES ITS ROUTE TO WS	NO SW REQ.	(OLT) ESTABLISHES ITS ROUTE TO WS	DETECT SW REQ. BY WORKING SF; SL IS WORKING AT WS; UPDATE T-K1 BYTE	ROUTER AND SL ARE OPERATING AT WS	S32
	SW REQ. BY WORKING SF	(ONU) ESTABLISHES ITS ROUTE TO WS	ACK	(OLT) ESTABLISHES ITS ROUTE TO SS	DETECT SW REQ. BY WORKING SF; SL IS WORKING AT WS; UPDATE T-K1 BYTE	DETECT RR BY RECEIVING K1/K2 BYTES; ROUTER IS SWITCHED TO SS; UPDATE T-K1/K2 BYTES	S33
	SW REQ. BY WORKING SF	(ONU) ESTABLISHES ITS ROUTE TO SS	ACK	(OLT) ESTABLISHES ITS ROUTE TO SS	DETECT RR BY RECEIVING K1/K2 BYTES; SL IS SWITCHED TO SS; ROUTER IS SWITCHED TO SS; UPDATE T-K2 BYTE	DETECT RR BY RECEIVING K1/K2 BYTES; ROUTER IS SWITCHED TO SS; UPDATE T-K1/K2 BYTES	S34
	SW REQ. BY WORKING SF	(ONU) ESTABLISHES ITS ROUTE TO SS	ACK	(OLT) ESTABLISHES ITS ROUTE TO SS	DETECT RR BY RECEIVING K1/K2 BYTES; SL IS SWITCHED TO SS; ROUTER IS SWITCHED TO SS; UPDATE T-K2 BYTE	DETECT RR BY RECEIVING K1/K2 BYTES; SL IS SWITCHED TO SS	S35
EQUIPMENT FAILURE IS RESTORED IN WS TX/RX OF ONU	REQUESTING TO REVERT TO WS	(ONU) ESTABLISHES ITS ROUTE TO SS	ACK	(OLT) ESTABLISHES ITS ROUTE TO SS	DETECT SW REQ. CLEAR; WAIT TO REVERT STATE; UPDATE T-K1 BYTE	START RESTORE TIMER; SL IS OPERATING AT SS	S51

FIG.16

REVERSION WAITING EXPIRES AT OLT	WAITING TO REVERT TO WS	(ONU) ESTABLISHES ITS ROUTE TO SS	NO SW REQ.	(OLT) ESTABLISHES ITS ROUTE TO WS	DETECT SW REQ. CLEAR; WAIT TO REVERT STATE; UPDATE T-K1 BYTE	STOP RESTORE TIMER; ROUTER IS SWITCHED TO WS; NO SW REQ. STATE; UPDATE T-K1/K2 BYTES	S52
	NO SW REQ.	(ONU) ESTABLISHES ITS ROUTE TO WS	NO SW REQ.	(OLT) ESTABLISHES ITS ROUTE TO WS	DETECT RR BY RECEIVING K1/K2 BYTES; SL IS SWITCHED TO WS; ROUTER IS SWITCHED TO WS; UPDATE T-K1/K2 BYTES	STOP RESTORE TIMER; ROUTER IS SWITCHED TO WS; NO SW REQ. STATE; UPDATE T-K1/K2 BYTES	S53
	NO SW REQ.	(ONU) ESTABLISHES ITS ROUTE TO WS	NO SW REQ.	(OLT) ESTABLISHES ITS ROUTE TO WS	DETECT RR BY RECEIVING K1/K2 BYTES; SL IS SWITCHED TO WS; ROUTER IS SWITCHED TO WS; UPDATE T-K1/K2 BYTES	DETECT RR BY RECEIVING K1/K2 BYTES; SL IS SWITCHED TO WS	S54

FIG.17

FAULT STATE	ONU TO OLT		OLT TO ONU		OPERATION		
	K1 BYTE	K2 BYTE	K1 BYTE	K2 BYTE	ONU	OLT	
NO FAILURE	NO SW REQ.	(ONU) ESTABLISHES ITS ROUTE TO WS	NO SW REQ.	(OLT) ESTABLISHES ITS ROUTE TO WS	ROUTER AND SL ARE OPERATING AT WS	ROUTER AND SL ARE OPERATING AT WS	S31
EQUIPMENT FAILURE OCCURS IN WS TX/RX OF ONU	SW REQ. BY WORKING SF	(ONU) ESTABLISHES ITS ROUTE TO WS	NO SW REQ.	(OLT) ESTABLISHES ITS ROUTE TO WS	DETECT SW REQ. BY WORKING SF; SL IS WORKING AT WS; UPDATE T-K1 BYTE	ROUTER AND SL ARE OPERATING AT WS	S32
	SW REQ. BY WORKING SF	(ONU) ESTABLISHES ITS ROUTE TO WS	ACK	(OLT) ESTABLISHES ITS ROUTE TO SS	DETECT SW REQ. BY WORKING SF; SL IS WORKING AT WS; UPDATE T-K1 BYTE	DETECT RR BY RECEIVING K1/K2 BYTES; ROUTER IS SWITCHED TO SS; UPDATE T-K1/K2 BYTES	S33
	SW REQ. BY WORKING SF	(ONU) ESTABLISHES ITS ROUTE TO SS	ACK	(OLT) ESTABLISHES ITS ROUTE TO SS	DETECT RR BY RECEIVING K1/K2 BYTES; SL IS SWITCHED TO SS; ROUTER IS SWITCHED TO SS; UPDATE T-K2 BYTE	DETECT RR BY RECEIVING K1/K2 BYTES; ROUTER IS SWITCHED TO SS; UPDATE T-K1/K2 BYTES	S34
	SW REQ. BY WORKING SF	(ONU) ESTABLISHES ITS ROUTE TO SS	ACK	(OLT) ESTABLISHES ITS ROUTE TO SS	DETECT RR BY RECEIVING K1/K2 BYTES; SL IS SWITCHED TO SS; ROUTER IS SWITCHED TO SS; UPDATE T-K2 BYTE	DETECT RR BY RECEIVING K1/K2 BYTES; SL IS SWITCHED TO SS	S35
EQUIPMENT FAILURE IS RESTORED IN WS TX/RX OF ONU	DO NOT REVERT TO WS	(ONU) ESTABLISHES ITS ROUTE TO SS	ACK	(OLT) ESTABLISHES ITS ROUTE TO SS	DETECT SW REQ. CLEAR; DO NOT REVERT STATE; UPDATE T-K1 BYTE	DETECT RR BY RECEIVING K1/K2 BYTES; SL IS SWITCHED TO SS	S36
	DO NOT REVERT TO WS	(ONU) ESTABLISHES ITS ROUTE TO SS	DO NOT REVERT TO WS	(OLT) ESTABLISHES ITS ROUTE TO SS	DETECT SW REQ. CLEAR; DO NOT REVERT STATE; UPDATE T-K1 BYTE	DETECT RR RELEASE BY RECEIVING K1/K2 BYTES; DO NOT REVERT STATE; UPDATE T-K1 BYTE	S36'

FIG.18

SIGNAL DEGRADE OCCURS IN SS TX/RX OF ONU	SW REQ. BY STANDBY SD	(ONU) ESTABLISHES ITS ROUTE TO SS	DO NOT REVERT TO WS	(OLT) ESTABLISHES ITS ROUTE TO SS	DETECT SW REQ. BY STANDBY SD; SL IS OPERATING AT SS; UPDATE T-K1 BYTE	DETECT RR RELEASE BY RECEIVING K1/K2 BYTES; DO NOT REVERT STATE; UPDATE T-K1 BYTE	S37'
	SW REQ. BY STANDBY SD	((ONU) ESTABLISHES ITS ROUTE TO SS	ACK	(OLT) ESTABLISHES ITS ROUTE TO WS	DETECT SW REQ. BY STANDBY SD; SL IS OPERATING AT SS; UPDATE T-K1 BYTE	DETECT RR BY RECEIVING K1/K2 BYTES; ROUTER IS SWITCHED TO SS; UPDATE T-K1/K2 BYTES	S38
	SW REQ. BY STANDBY SD	(ONU) ESTABLISHES ITS ROUTE TO WS	ACK	(OLT) ESTABLISHES ITS ROUTE TO WS	DETECT RR BY RECEIVING K1/K2 BYTES; SL IS SWITCHED TO SS; ROUTER IS SWITCHED TO SS; UPDATE T-K2 BYTE	DETECT RR BY RECEIVING K1/K2 BYTES; ROUTER IS SWITCHED TO SS; UPDATE T-K1/K2 BYTES	S39
	SW REQ. BY STANDBY SD	(ONU) ESTABLISHES ITS ROUTE TO WS	ACK	(OLT) ESTABLISHES ITS ROUTE TO WS	DETECT RR BY RECEIVING K1/K2 BYTES; SL IS SWITCHED TO SS; ROUTER IS SWITCHED TO SS; UPDATE T-K2 BYTE	DETECT RR BY RECEIVING K1/K2 BYTES; SL IS SWITCHED TO SS	S40
SIGNAL DEGRADE IS RESTORED IN SS TX/RX OF ONU	NO SW REQ.	(ONU) ESTABLISHES ITS ROUTE TO WS	ACK	(OLT) ESTABLISHES ITS ROUTE TO WS	NO REQ.; UPDATE K1 BYTE	DETECT RR BY RECEIVING K1/K2 BYTES; SL IS SWITCHED TO SS	S41
	NO SW REQ.	(ONU) ESTABLISHE S ITS ROUTE TO WS	NO SW REQ.	(OLT) ESTABLISHES ITS ROUTE TO WS	NO REQ.; UPDATE K1 BYTE	NO REQ.; UPDATE K1 BYTE	S42

FIG.19

FAULT STATE	ONU TO OLT		OLT TO ONU		OPERATION		
	K1 BYTE	K2 BYTE	K1 BYTE	K2 BYTE	ONU	OLT	
NO FAILURE	NO SW REQ.	(ONU) ESTABLISHES ITS ROUTE TO WS	NO SW REQ.	(OLT) ESTABLISHES ITS ROUTE TO WS	ROUTER AND SL ARE OPERATING AT WS	ROUTER AND SL ARE OPERATING AT WS	S31
EQUIPMENT FAILURE OCCURS IN WS TX/RX OF ONU	SW REQ. BY WORKING SF	(ONU) ESTABLISHES ITS ROUTE TO WS	NO SW REQ.	(OLT) ESTABLISHES ITS ROUTE TO WS	DETECT SW REQ. BY WORKING SF; SL IS WORKING AT WS; UPDATE T-K1 BYTE	ROUTER AND SL ARE OPERATING AT WS	S32
	SW REQ. BY WORKING SF	(ONU) ESTABLISHES ITS ROUTE TO WS	ACK	(OLT) ESTABLISHES ITS ROUTE TO SS	DETECT SW REQ. BY WORKING SF; SL IS WORKING AT WS; UPDATE T-K1 BYTE	DETECT RR BY RECEIVING K1/K2 BYTES; ROUTER IS SWITCHED TO SS; UPDATE T-K1/K2 BYTES	S33
	SW REQ. BY WORKING SF	(ONU) ESTABLISHES ITS ROUTE TO SS	ACK	(OLT) ESTABLISHES ITS ROUTE TO SS	DETECT RR BY RECEIVING K1/K2 BYTES; SL IS SWITCHED TO SS; ROUTER IS SWITCHED TO SS; UPDATE T-K2 BYTE	DETECT RR BY RECEIVING K1/K2 BYTES; ROUTER IS SWITCHED TO SS; UPDATE T-K1/K2 BYTES	S34
	SW REQ. BY WORKING SF	(ONU) ESTABLISHES ITS ROUTE TO SS	ACK	(OLT) ESTABLISHES ITS ROUTE TO SS	DETECT RR BY RECEIVING K1/K2 BYTES; SL IS SWITCHED TO SS; ROUTER IS SWITCHED TO SS; UPDATE T-K2 BYTE	DETECT RR BY RECEIVING K1/K2 BYTES; SL IS SWITCHED TO SS	S35
EQUIPMENT FAILURE IN WS RX OF ONU IS RESTORED	REQUESTING TO REVERT TO WS.	(ONU) ESTABLISHES ITS ROUTE TO SS	ACK	(OLT) ESTABLISHES ITS ROUTE TO SS	DETECT SW REQ. CLEAR; WAIT TO REVERT STATE; UPDATE T-K1 BYTE	DETECT RR BY RECEIVING K1/K2 BYTES; SL IS SWITCHED TO SS	S51
	REQUESTING TO REVERT TO WS.	(ONU) ESTABLISHES ITS ROUTE TO SS	REQUESTING TO REVERT TO WS	(OLT) ESTABLISHES ITS ROUTE TO SS	DETECT SW REQ. CLEAR; WAIT TO REVERT STATE; UPDATE T-K1 BYTE	DETECT RR RELEASE BY RECEIVING K1/K2 BYTES; WAIT TO REVERT STATE; START RESTORE TIMER; UPDATE T-K1 BYTE	S51'

FIG.20

REVERSION WAITING EXPIRES AT OLT	WAITING TO REVERT TO WS	(ONU) ESTABLISHES ITS ROUTE TO SS	NO SW REQ.	(OLT) ESTABLISHES ITS ROUTE TO WS	DETECT SW REQ. CLEAR; WAIT TO REVERT STATE; UPDATE T-K1 BYTE	STOP RESTORE TIMER; ROUTER IS SWITCHED TO WS; NO SW REQ. STATE; UPDATE T-K1/K2 BYTES	S52
	NO SW REQ.	(ONU) ESTABLISHES ITS ROUTE TO WS	NO SW REQ.	(OLT) ESTABLISHES ITS ROUTE TO WS	DETECT RR BY RECEIVING K1/K2 BYTES; SL IS SWITCHED TO WS; ROUTER IS SWITCHED TO WS; UPDATE T-K1/K2 BYTES	STOP RESTORE TIMER; ROUTER IS SWITCHED TO WS; NO SW REQ. STATE; UPDATE T-K1/K2 BYTES	S53
	NO SW REQ.	(ONU) ESTABLISHES ITS ROUTE TO WS	NO SW REQ.	(OLT) ESTABLISHES ITS ROUTE TO WS	DETECT RR BY RECEIVING K1/K2 BYTES; SL IS SWITCHED TO WS; ROUTER IS SWITCHED TO WS; UPDATE T-K1/K2 BYTES	DETECT RR BY RECEIVING K1/K2 BYTES; SL IS SWITCHED TO WS	S54

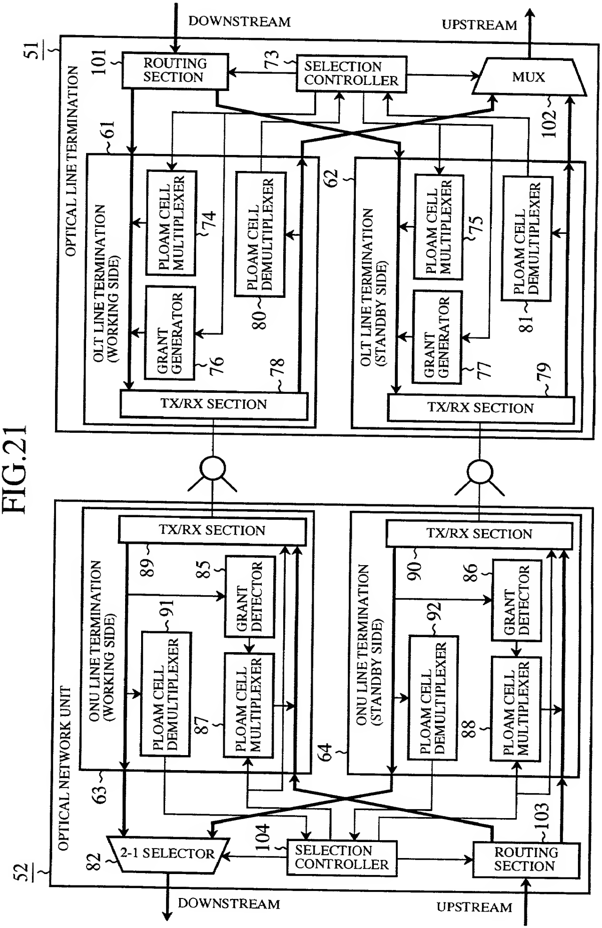

DOWNSTREAM
UPSTREAM
51
OPTICAL LINE TERMINATION
101
ROUTING SECTION
73
SELECTION CONTROLLER
MUX
102
61
OLT LINE TERMINATION (WORKING SIDE)
PLOAM CELL MULTIPLEXER
74
GRANT GENERATOR
76
PLOAM CELL DEMULTIPLEXER
80
78
TX/RX SECTION
62
OLT LINE TERMINATION (STANDBY SIDE)
PLOAM CELL MULTIPLEXER
75
GRANT GENERATOR
77
PLOAM CELL DEMULTIPLEXER
81
79
TX/RX SECTION
52
OPTICAL NETWORK UNIT
63
ONU LINE TERMINATION (WORKING SIDE)
TX/RX SECTION
89
85
GRANT DETECTOR
91
PLOAM CELL DEMULTIPLEXER
87
PLOAM CELL MULTIPLEXER
64
ONU LINE TERMINATION (STANDBY SIDE)
TX/RX SECTION
90
86
GRANT DETECTOR
92
PLOAM CELL DEMULTIPLEXER
88
PLOAM CELL MULTIPLEXER
82
2-1 SELECTOR
104
SELECTION CONTROLLER
103
ROUTING SECTION
DOWNSTREAM
UPSTREAM

FIG.21

FIG.22

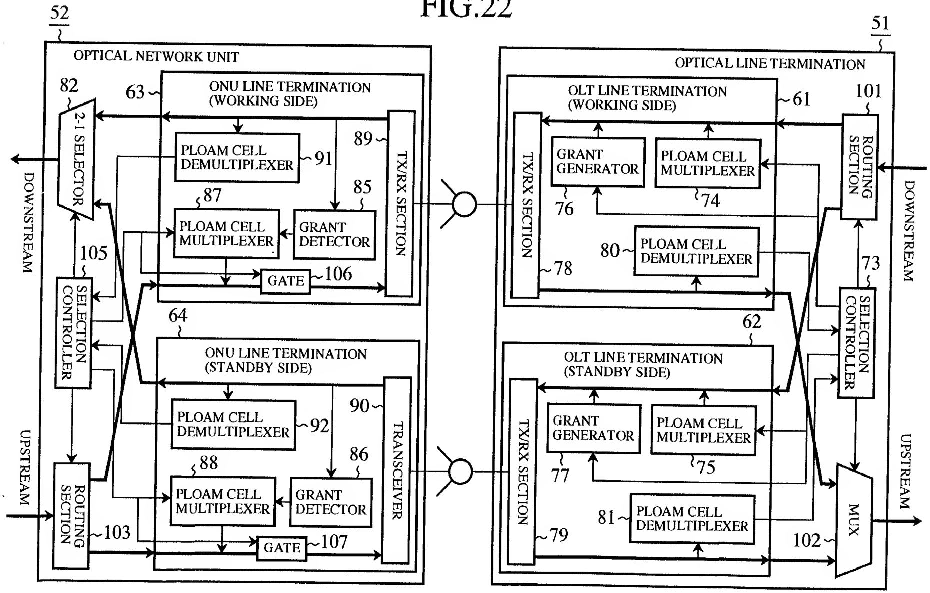

52
OPTICAL NETWORK UNIT
82
2-1 SELECTOR
DOWNSTREAM
63
ONU LINE TERMINATION (WORKING SIDE)
PLOAM CELL DEMULTIPLEXER
91
89
TX/RX SECTION
87
PLOAM CELL MULTIPLEXER
85
GRANT DETECTOR
105
SELECTION CONTROLLER
GATE
106
64
ONU LINE TERMINATION (STANDBY SIDE)
PLOAM CELL DEMULTIPLEXER
92
90
TRANSCEIVER
88
PLOAM CELL MULTIPLEXER
86
GRANT DETECTOR
UPSTREAM
ROUTING SECTION
103
GATE
107
51
OPTICAL LINE TERMINATION
OLT LINE TERMINATION (WORKING SIDE)
61
101
TX/RX SECTION
GRANT GENERATOR
PLOAM CELL MULTIPLEXER
ROUTING SECTION
DOWNSTREAM
76
74
80
PLOAM CELL DEMULTIPLEXER
73
78
SELECTION CONTROLLER
62
OLT LINE TERMINATION (STANDBY SIDE)
TX/RX SECTION
GRANT GENERATOR
PLOAM CELL MULTIPLEXER
77
75
81
PLOAM CELL DEMULTIPLEXER
MUX
UPSTREAM
79
102

FIG.23

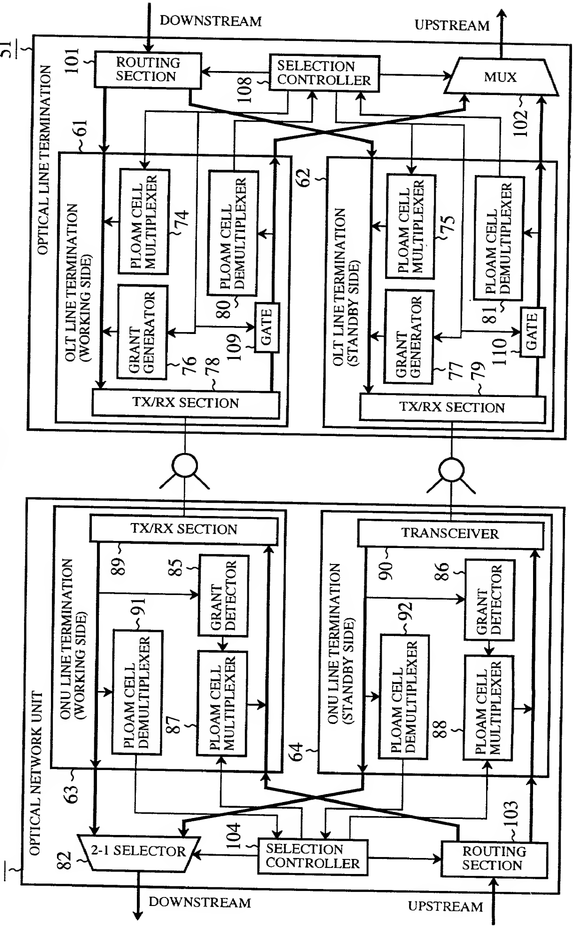
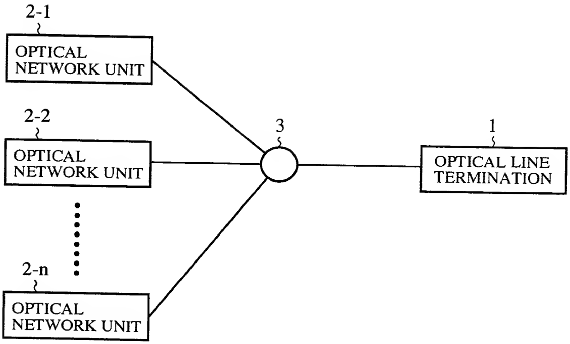

DOWNSTREAM
UPSTREAM
51
OPTICAL LINE TERMINATION
101
ROUTING SECTION
108
SELECTION CONTROLLER
MUX
102
61
OLT LINE TERMINATION (WORKING SIDE)
PLOAM CELL MULTIPLEXER
74
PLOAM CELL DEMULTIPLEXER
80
GRANT GENERATOR
76
78
109
GATE
TX/RX SECTION
62
OLT LINE TERMINATION (STANDBY SIDE)
PLOAM CELL MULTIPLEXER
75
PLOAM CELL DEMULTIPLEXER
81
GRANT GENERATOR
77
79
110
GATE
TX/RX SECTION
52
OPTICAL NETWORK UNIT
63
ONU LINE TERMINATION (WORKING SIDE)
TX/RX SECTION
89
85
GRANT DETECTOR
91
PLOAM CELL DEMULTIPLEXER
87
PLOAM CELL MULTIPLEXER
64
ONU LINE TERMINATION (STANDBY SIDE)
TRANSCEIVER
90
86
GRANT DETECTOR
92
PLOAM CELL DEMULTIPLEXER
88
PLOAM CELL MULTIPLEXER
82
2-1 SELECTOR
104
SELECTION CONTROLLER
ROUTING SECTION
103
DOWNSTREAM
UPSTREAM

FIG.24 (PRIOR ART)



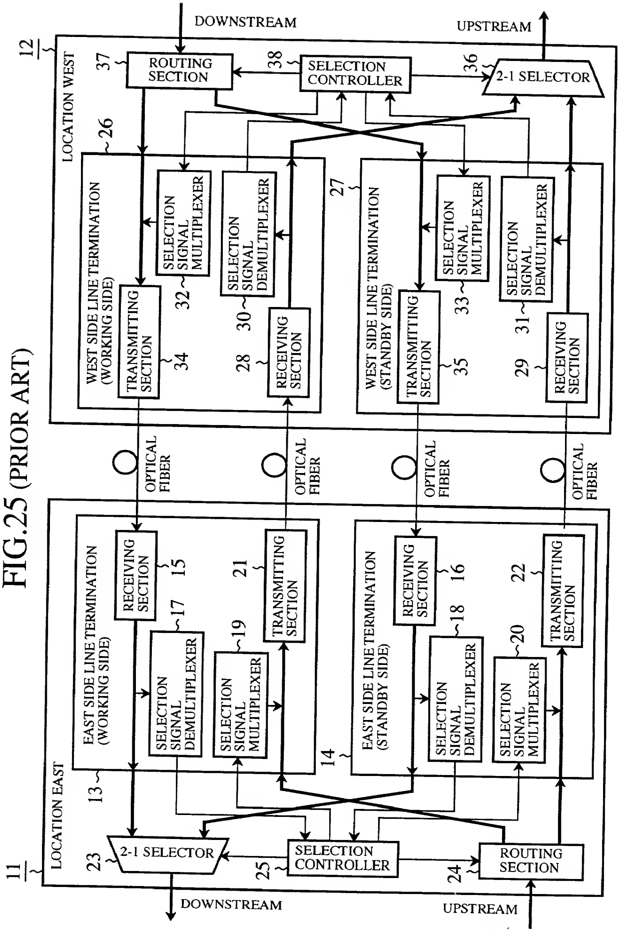


FIG.25 (PRIOR ART)

CONTROL EXAMPLE (NON-REVERTIVE MODE)

FIG.26 (PRIOR ART)

FAULT STATE	LE TO LW		LW TO LE		OPERATION		
	K1 BYTE	K2 BYTE	K1 BYTE	K2 BYTE	LE	LW	
NO FAILURE	NO SW REQ.	(LE IS) SELECTING WS	NO SW REQ.	(LW IS) SELECTING WS	SL IS OPERATING IN WS	SL IS OPERATING IN WS	~S1
EQUIPMENT FAILURE OCCURS IN WS RX OF LE	SW REQ. BY WORKING SF	(LE IS) SELECTING SS	NO SW REQ.	(LW IS) SELECTING WS	DETECT SW REQ. BY WORKING SF; SL IS SWITCHED TO SS; UPDATE T-K1/K2 BYTES	SL IS OPERATING IN WS	~S2
	SW REQ. BY WORKING SF	(LE IS) SELECTING SS	NO SW REQ.	(LW IS) SELECTING SS	DETECT SW REQ. BY WORKING SF; SL IS SWITCHED TO SS; UPDATE T-K1/K2 BYTES	DETECT RR BY RECEIVING K1/K2; SL IS SWITCHED TO SS; UPDATE T-K2 BYTE	~S3
EQUIPMENT FAILURE IS RESTORED IN WS RX OF LE	DO NOT REVERT TO WS	(LE IS) SELECTING SS	NO SW REQ.	(LW IS) SELECTING SS	DETECT SW REQ. CLEAR; DO NOT REVERT STATE; UPDATE T-K1 BYTE	DETECT RR BY RECEIVING K1/K2; SL IS SWITCHED TO SS; UPDATE T-K2 BYTE	~S4
SIGNAL DEGRADE OCCURS IN SS RX OF LE	SW REQ. BY STANDBY SD	(LE IS) SELECTING WS	NO SW REQ.	(LW IS) SELECTING SS	DETECT SW REQ. BY WORKING SD; SL IS SWITCHED TO WS; UPDATE T-K1/K2 BYTES	DETECT RR BY RECEIVING K1/K2; SL IS SWITCHED TO SS; UPDATE T-K2 BYTE	~S5
	SW REQ. BY STANDBY SD	(LE IS) SELECTING WS	NO SW REQ.	(LW IS) SELECTING WS	DETECT SW REQ. BY WORKING SD; SL IS SWITCHED TO WS; UPDATE T-K1/K2 BYTES	DETECT RR BY RECEIVING K1/K2; SL IS SWITCHED TO WS; UPDATE T-K2 BYTE	~S6
SIGNAL DEGRADE IS RESTORED IN SS RX OF LE	NO SW REQ.	(LE IS) SELECTING WS	NO SW REQ.	(LW IS) SELECTING WS	NO REQ.; UPDATE K1 BYTE	DETECT RR BY RECEIVING K1/K2; SL IS SWITCHED TO WS; UPDATE T-K2 BYTE	~S7

NOTE: LE=LOCATION EAST; LW=LOCATION WEST